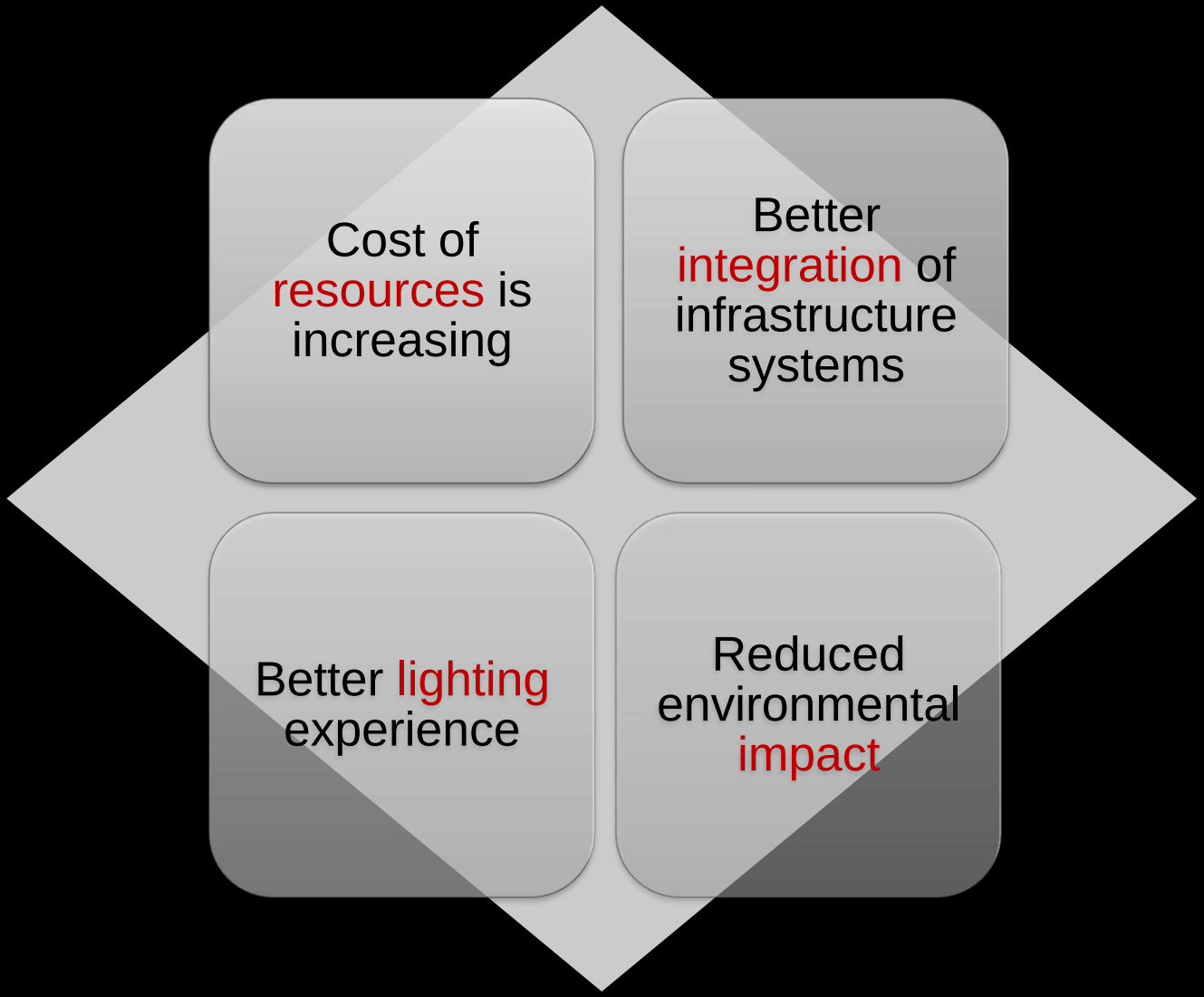
# Technology – Lighting the way to tomorrow

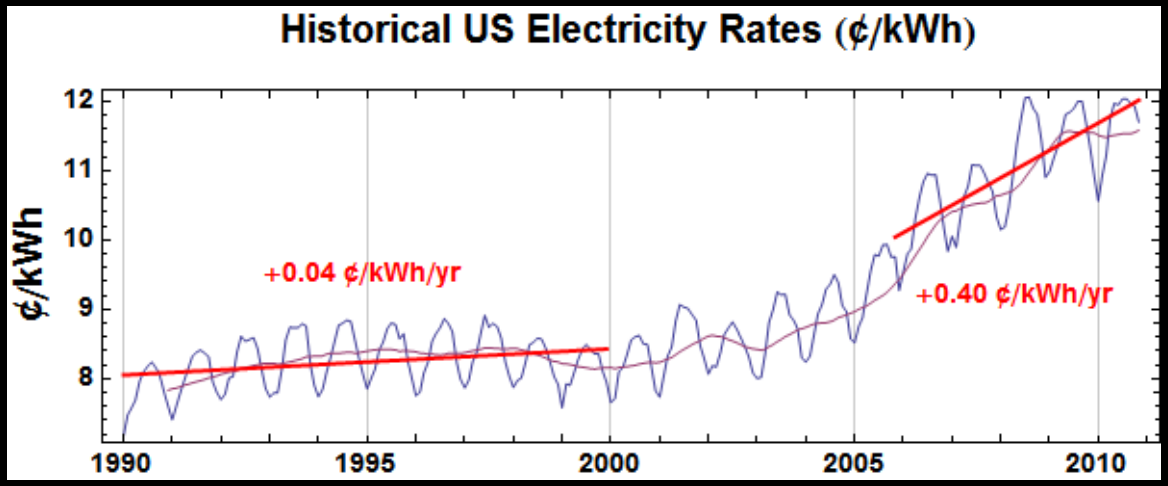
By Jeff Quinlan

# Major Trends

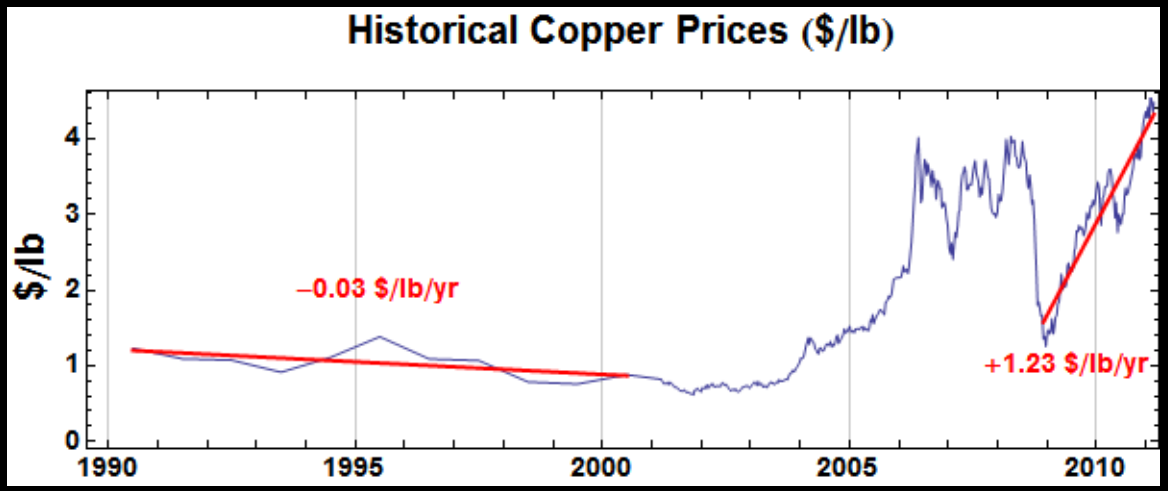


# Resource costs increasing

Electricity



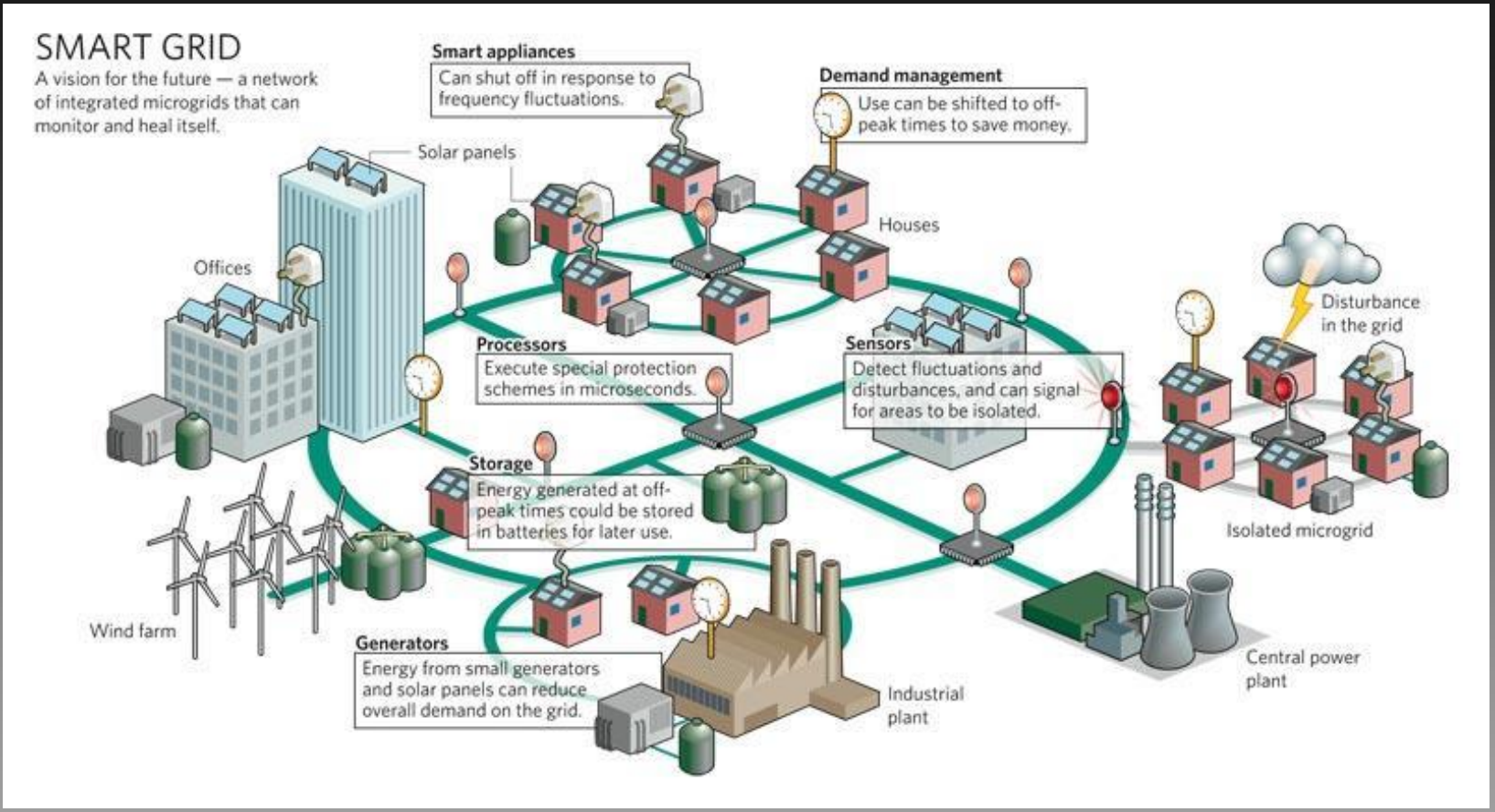

Materials



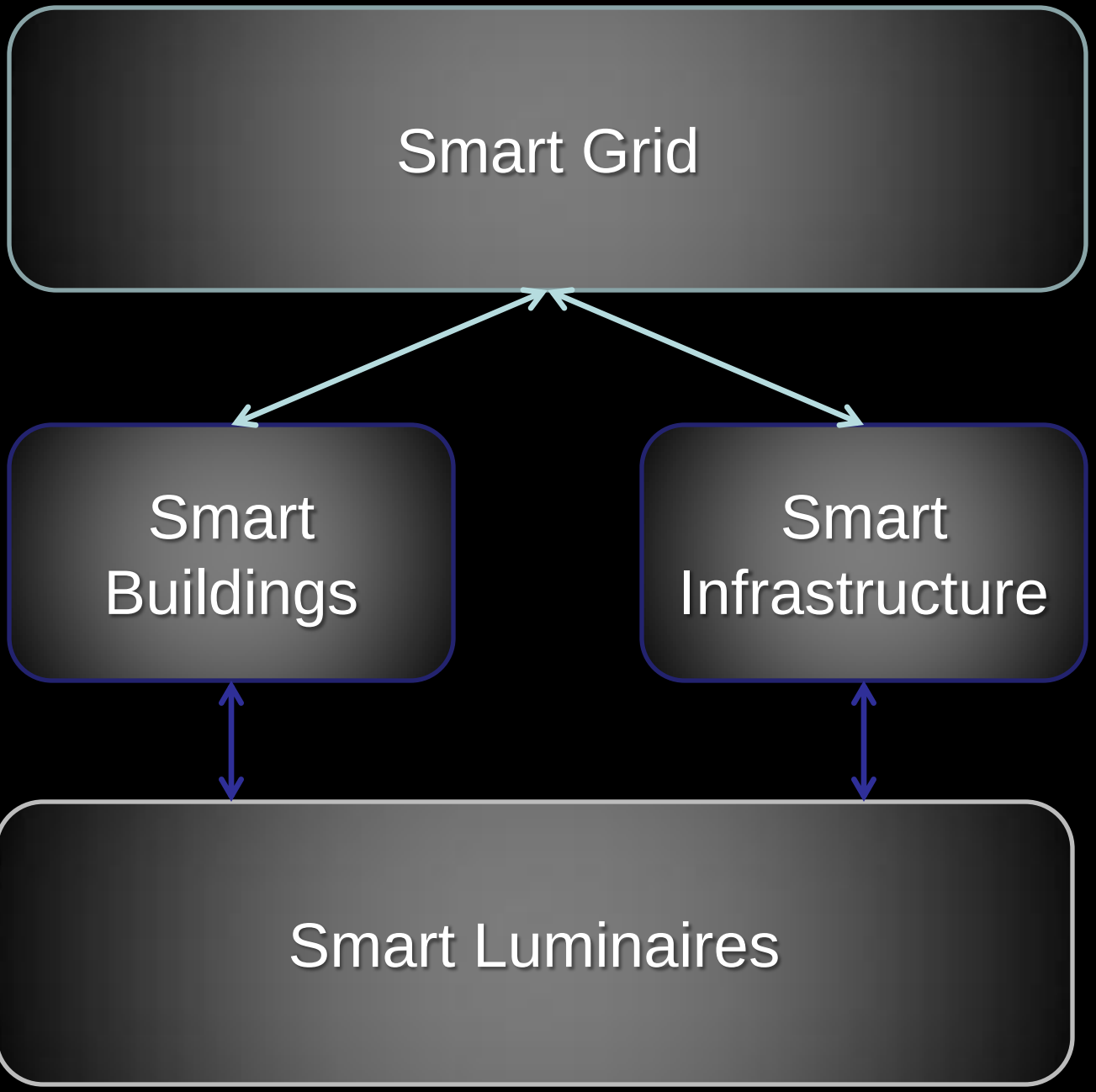

Data source: Wolfram Alpha 2011

# Better Integration

- What is the Smart Grid?

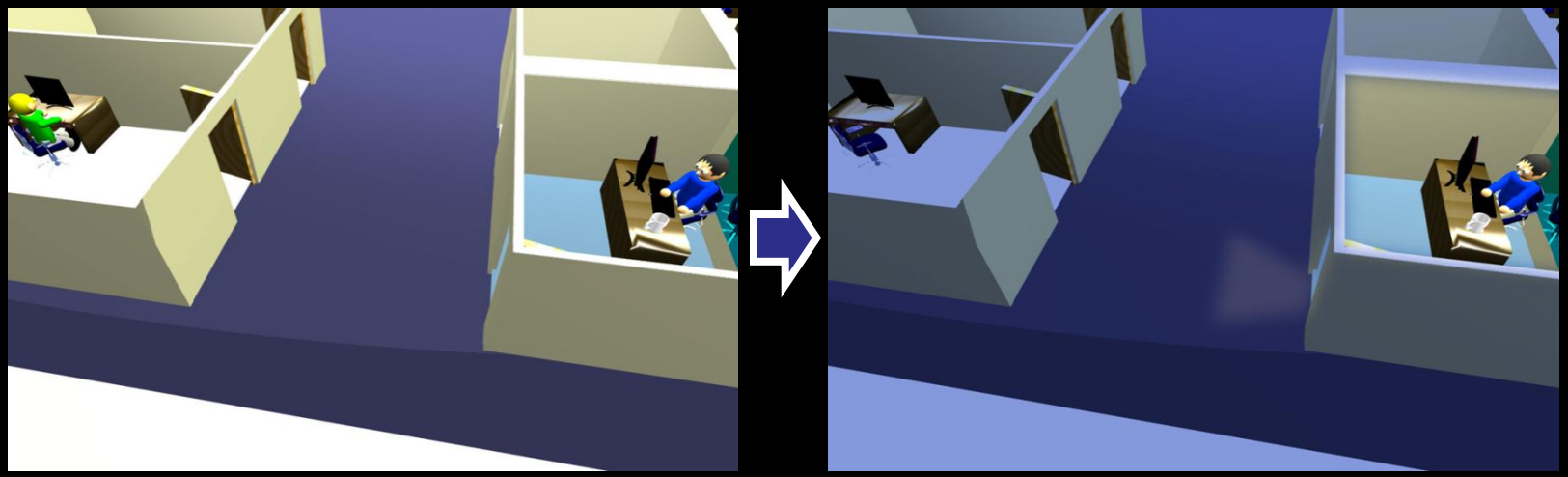



http://www.consumerenergyreport.com/2010/04/12/us-invests-in-smart-grid-training/


Smart Grid
Smart Buildings
Smart Infrastructure
Smart Luminaires

# Smart Grid to Smart Luminaires

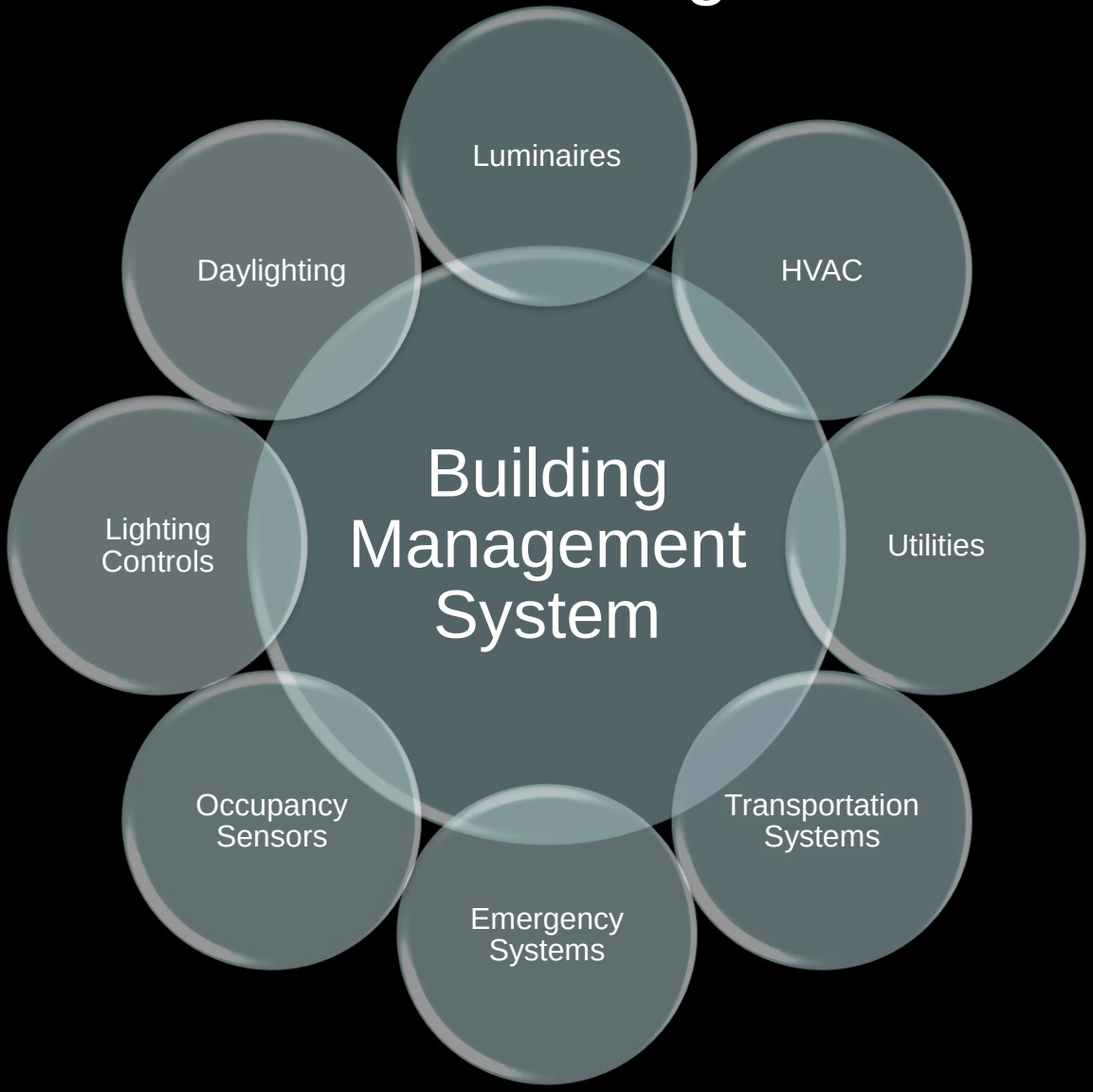
- How can the Smart Grid interact with Lighting Systems?

Images from: http://www.sensorswitch.com/nlight/docs/nLight_overview.ppt

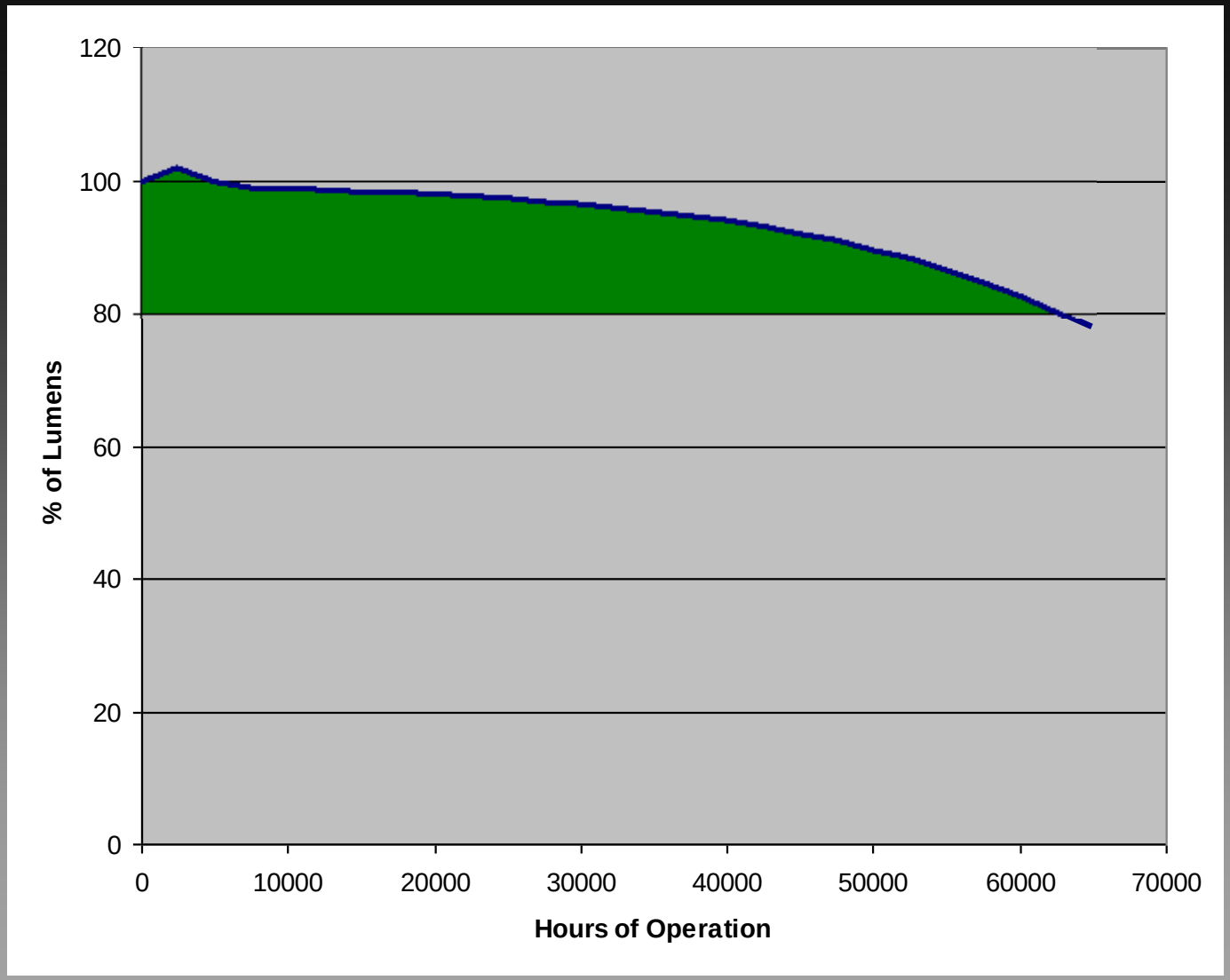
# Smart Grid to Smart Luminaires

- What is a Smart Building?



# Smart Luminaires

- Too Much Lighting



# Outdoor LED Controls

**Good Solution**

ON/OFF Control

Part Night

Zone Control

# Outdoor LED Controls

Better Solution

Bi-level

Part Night

Zone Control

# Outdoor LED Controls

## Best Solution

ROAM Control

Monitoring, Performance Validation

- Full Range Dimming
- Customer Driven Scheduling
- Infinitely Adjustable Over the Life of the Installation

# Better Lighting Experience

# Tailored Lighting

A system that provides only:

- The necessary amount of light
- With the proper qualities
- In the correct locations
- When needed

# Tailored Lighting

Yesterday

Tomorrow

# Tailored Lighting

How much light is necessary?

- What are the visual tasks?
- How have things changed?
- How can lighting enable/enhance performance?
- And hinder it?
- What are the consequences of falling short?
- What additional needs must be served?
- Specifically, what do we value in lighting?

the spec. says 30fc on the task…

so how do we capture everything else we value about lighting?

# Tailored Lighting

- How do we measure performance?

# Tailored Lighting

Which qualities matter?

- Color attributes
  - CRI, CQS, GAI, CCT, other
- Modeling and directionality
- Uniformity over the visual task
- Glare control
- Temporal characteristics

# Tailored Lighting

What must be lighted?

# Tailored Lighting

What must be lighted?

- Task surfaces
- Ambient illumination
- Accent lighting
- Way-finding

# Tailored Lighting

And, when?

- Lighting on demand (task)
- Supplementing daylight
- Occupancy sensing
- Time-based control

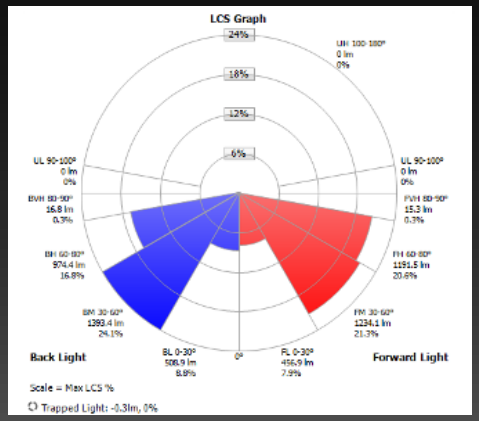
# Tailored Lighting

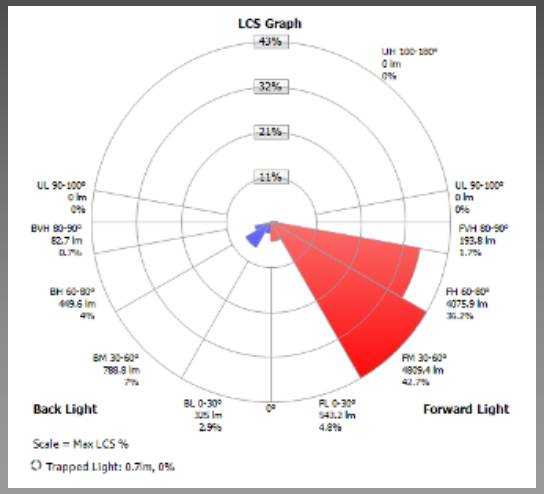
How?

- Layers
- Photometric specificity
- Sensing and control
- Flexibility

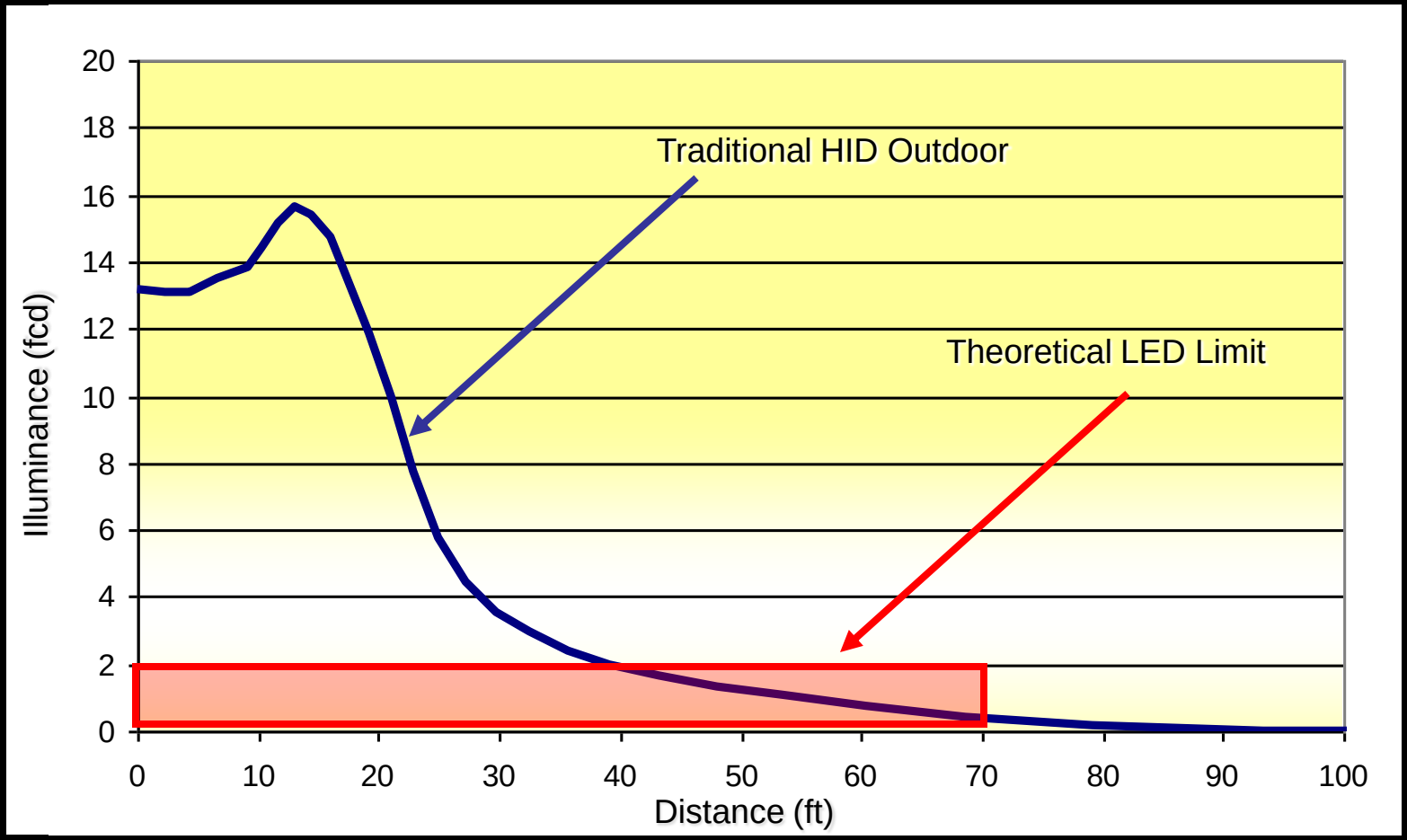
# Efficiency / Efficacy / Effectiveness

- efficiency is not a good measure
- what about flux on task?



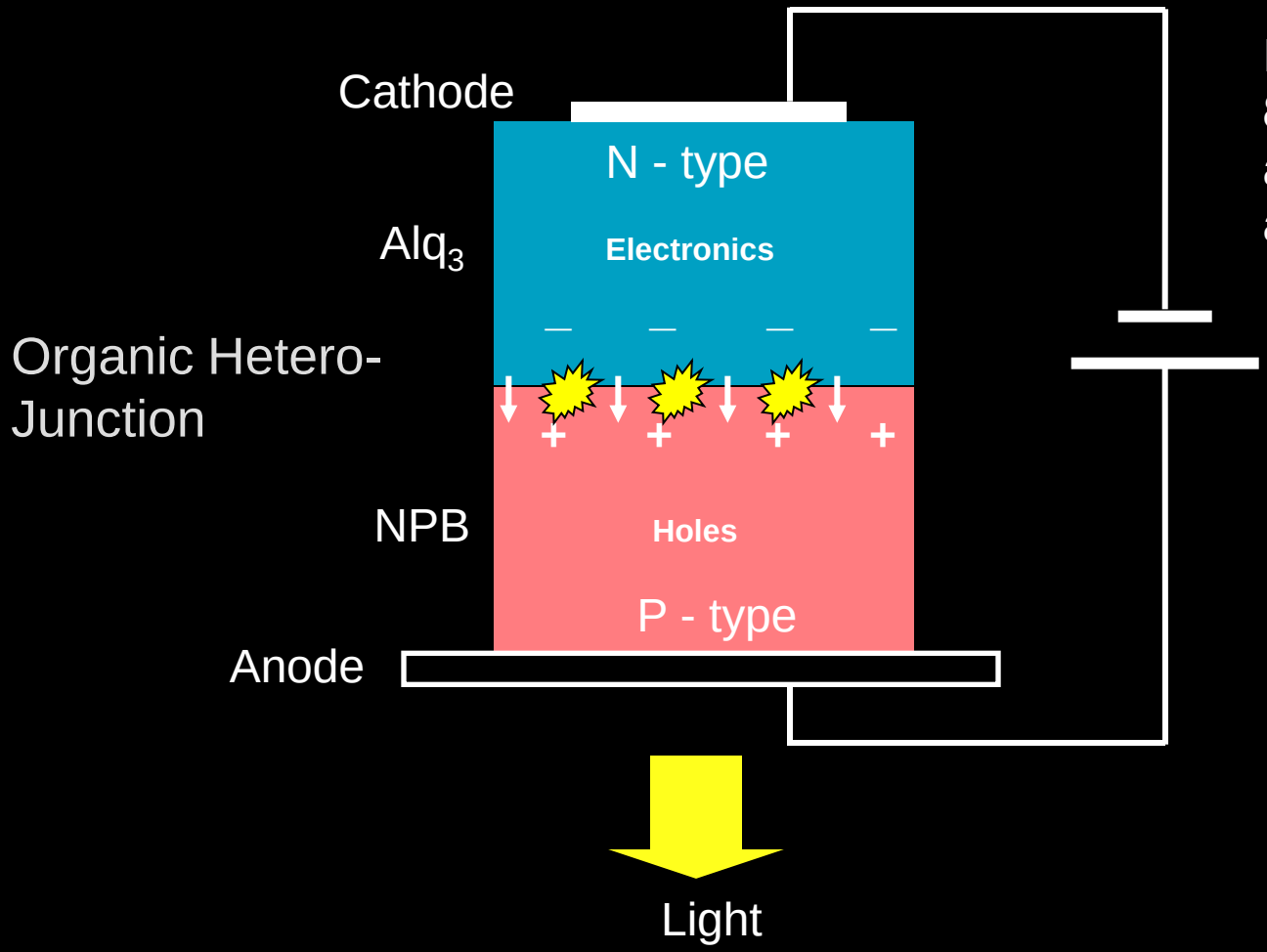
# Application Efficacy



# Organic Light Emitting Diodes

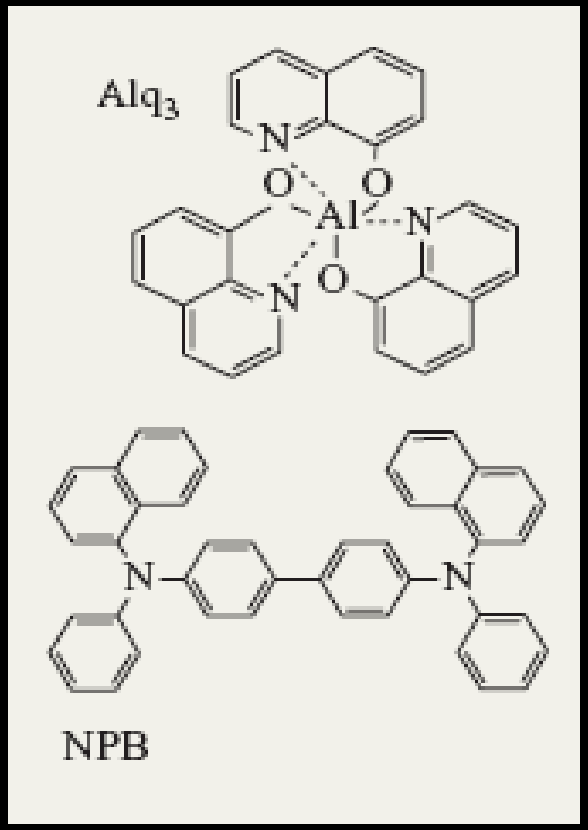
- OLEDs
  - What they are

# OLED Basics




Invented in mid-late 80's by Ching Tang and Steve Van Slyke at Eastman Kodak.

# Organic Semiconductors




**alq3 (tris-8-hydroxyquinoline aluminum)**

**NPB (Bis[N-(1-naphthyl)-N-phenyl]Benzidine)**

# OLED Performance Roadmap

Not An Issue

**Image**

**Current**

**Specialty and High End Standard**

**2012 -2014**

**Specification Grade**

**2015 -2017**

**Commodity Grade**

**2018-**

Efficacy, Lumen Output (Luminance), Life, Cost Effectiveness

# ABL OLED

**LightFacet™**

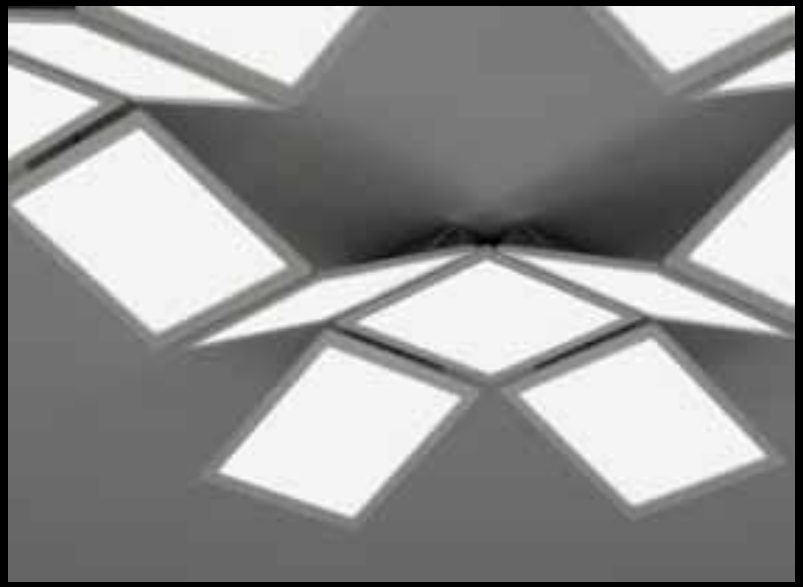
**LightPod™**

OLED LIGHTING DESIGN CENTER

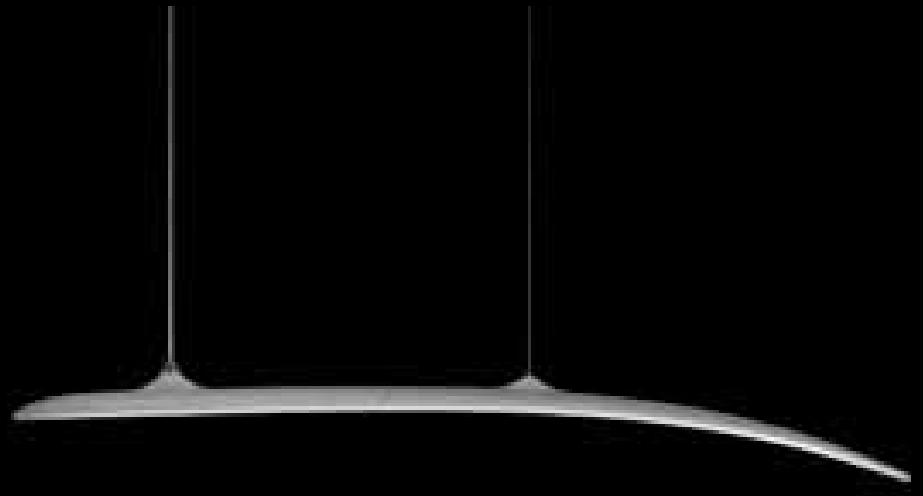
ACUITY BRANDS LIGHTING

# ABL OLED

**Revel™**



**Kindred™**

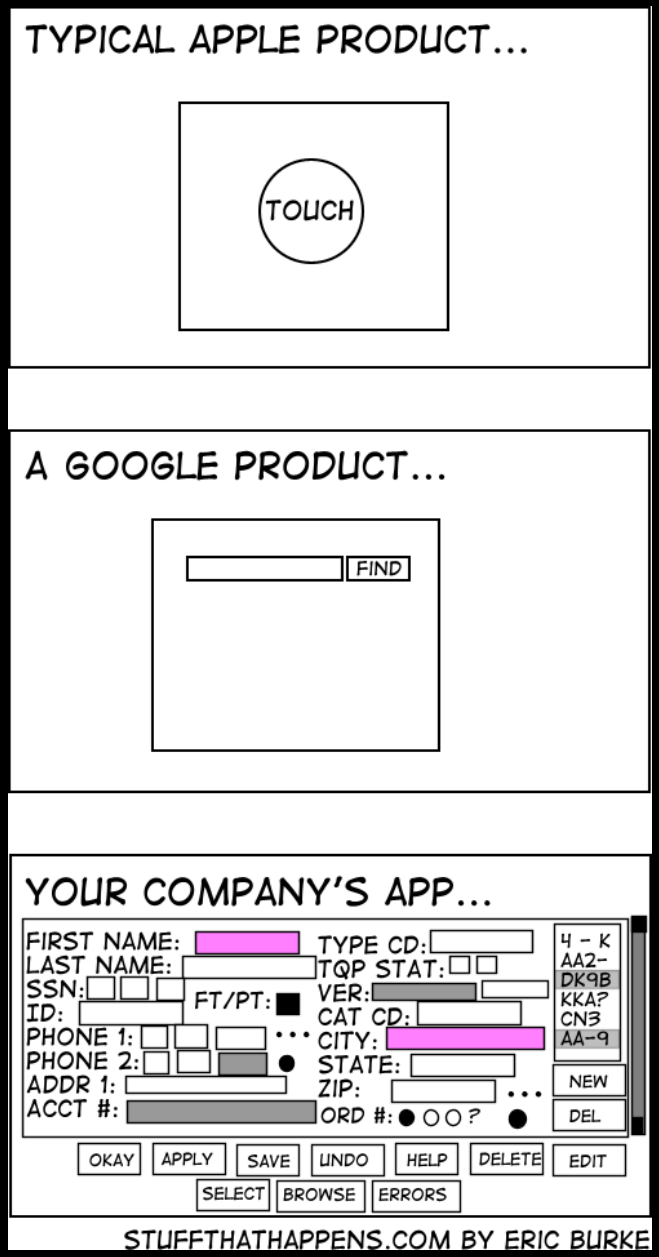


# Tailored Lighting

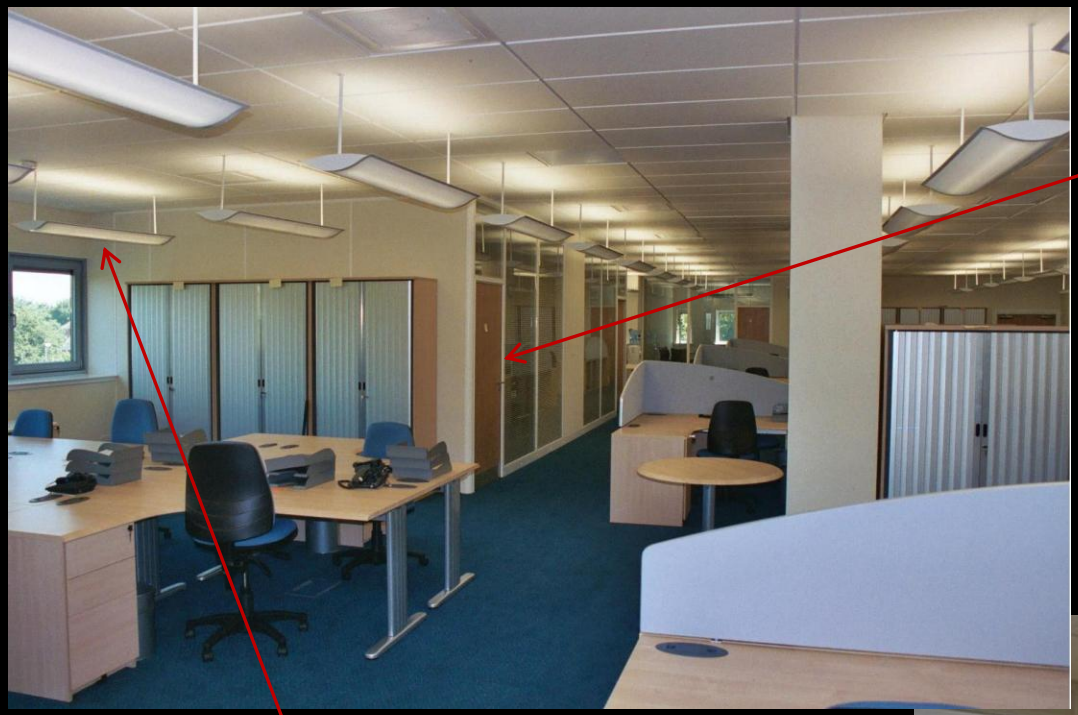
Conspicuous consumption


# COMPLEXITY → SIMPLICITY

Lighting systems should be highly controllable while still being easy and natural to use.




Pasted from
<http://stuffthathappens.com/blog/2008/03/05/simplicity/
>



Unused offices automatically turn off

Lighting and HVAC respond to occupancy

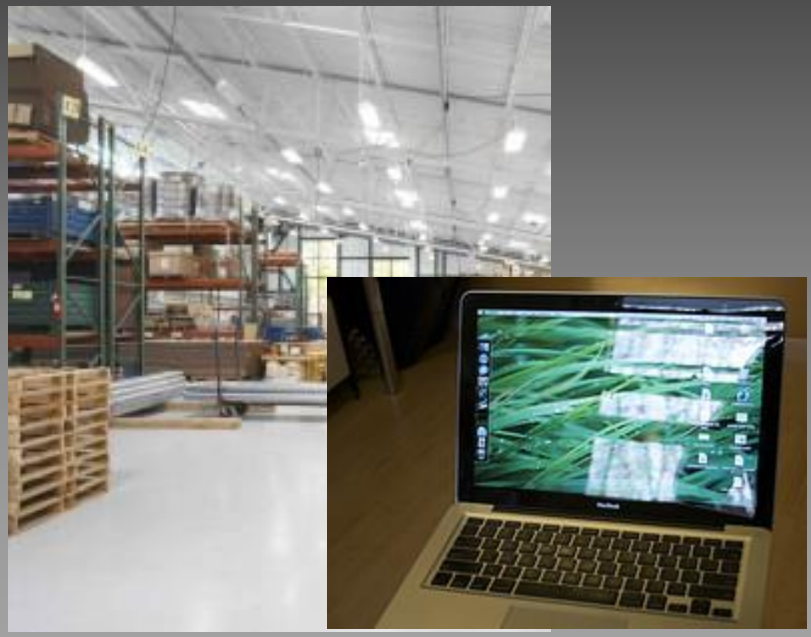
Lighting responds to daylight

Active sensors detect occupancy

# Reduced Environmental Impact

# Daylighting

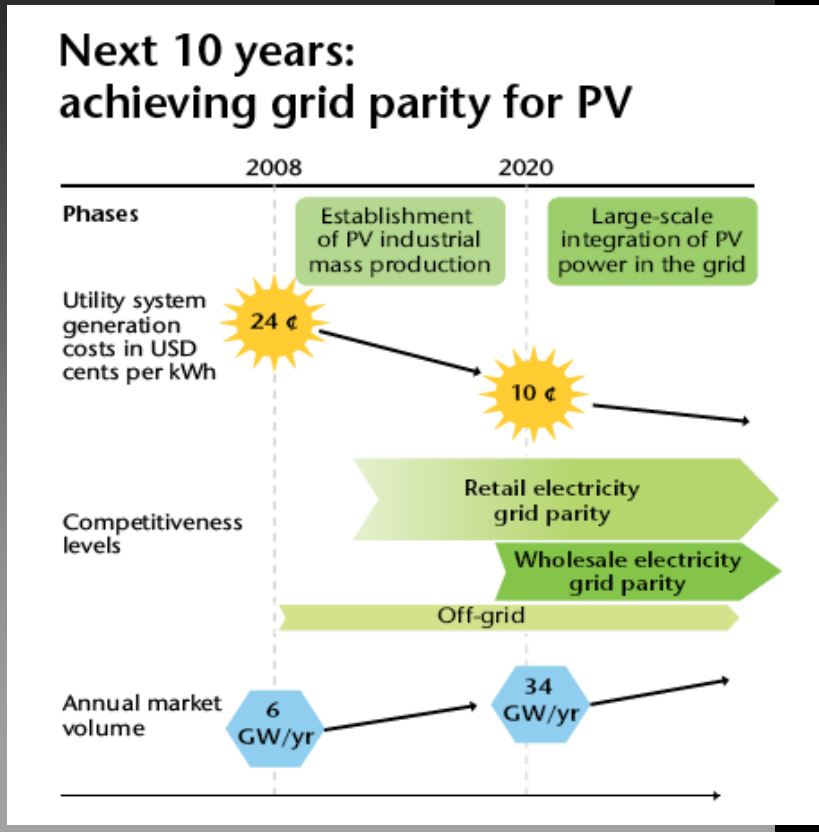
- Breaking news from the 1970's
- Coordinated controls between daylight and electric lighting
- What does success look like?
  - Occupants should not notice the change
    - Light levels
    - Color
    - Dimming vs. on / off
  - Non linear electric lighting response from windows.



# Photovoltaics

- According to IEA we expect 8 times increase in energy from PV in the coming decade.

- Produces DC electricity which is converted to AC …..
- Development of thin film technology will decrease cost
- Need to coordinate with power storage



# Thanks